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ABSTRACT

Microcomputers are now affordable tools for managing schools and school districts--and fast becoming essential. This digest, designed to help school administrators begin computerizing their offices, depicts tomorrow's computerized office, introduces computer applications in management, and outlines procedures for computerizing an office. A fictional principal in the first chapter uses his desktop computer--linked with others in a "local area network"--to communicate, to coordinate his staff, and to analyze information. Such networks can be developed with present technology. Accordingly, the second chapter explores the following computer applications: (1) database management systems, used to store and analyze a wide variety of records; (2) electronic spreadsheets, used to make budget projections and analyze expenditures; (3) word processing; (4) graphics; (5) communications and networking, particularly local area networks; and (6) others, including registration and class scheduling, support service management, energy management, and nonadministrative but related tasks. The final chapter describes and recommends a process for putting these technologies to work, modeled after professional systems development practices. The discussion includes independent school-based computerization, consulting services, systems analysis (evaluating needs and planning to meet them), systems development (creating detailed specifications and selecting technology), and system implementation. (MCG)

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Microcomputers in the School Office: Primer for Administrators

John Lindelow

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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Besides processing documents and journal articles, the Clearinghouse has another major function — information analysis and synthesis. The Clearinghouse prepares bibliographies, literature reviews, state-of-the-knowledge papers, and other interpretive research studies on topics in its educational area.

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Foreword

The ERIC Clearinghouse on Educational Management is pleased to add this report to the School Management Digest, a series designed to offer educational leaders essential information on a wide range of critical concerns in education.

At a time when decisions in education must be made on the basis of increasingly complex information, the Digest provides school administrators with concise, readable analyses of the most important trends in schools today. The goal of this analysis is improvement of educational practice. Each Digest points up the practical implications of major research findings so that its readers might better grasp and apply knowledge useful for the operation of the schools.

The author of this report, John Lindelow, was commissioned by the Clearinghouse as a research analyst and writer. We deeply appreciate his skill in organizing and bringing clarity to the large amount of information on the topic.

Philip K. Piele
Professor and Director

Introduction

When the subject of microcomputers comes up, most educators think immediately of the classroom. Computer-aided instruction (CAI), computer-managed instruction (CMI), and computer literacy training are topics that come easily to mind whenever the words "computer" and "school" are used in the same breath.

Yet there is another intersection of computers and schools that is often overlooked—the use of computers for the management of schools and districts. As microcomputers get cheaper, smaller, and more capable, they become readily available to smaller and more modestly funded organizations. This trend is apparent in the business world, where even Mom & Pop grocery stores are discovering the economics of computerizing their paperwork. In government, the new microtechnologies have percolated more slowly into the lower reaches of the hierarchies, but already tens of thousands of bureaucrats and government administrators have "micros" adorning their desks.

In education, computers have been used at the district level for many years. But now that the "information revolution" is in full bloom, both financially strapped and well-to-do school districts are discovering what most businesses have already found—it's no longer economical *not* to computerize at most management levels.

Changing from today's traditional office to tomorrow's electronic "paperless" office will admittedly be a complex undertaking. This digest is designed to help school administrators (many of whom may be computer novices) take their first steps toward office computerization. It provides an overview of the electronic school office, an introduction to the information tools needed, and an outline of the "systems development" process that school leaders must manage to guide their schools into the future. Most importantly, this digest provides a wealth of references to more comprehensive guidebooks and

manuals that will help school managers master the computerized school office of tomorrow.

The first chapter below paints a portrait of what administrative computing might be like in just a few years. All the technology referred to is now in existence, and many businesses, institutes, and government units have similar systems up and running today. Some forward-looking school districts as well may already be operating or implementing such systems.

The second chapter describes the many uses of personal computers in school management, with emphasis on the most useful available programs, such as electronic spreadsheets and database management systems. Included are discussions of record management, data analysis, word processing, graphics production, communications and networking, class scheduling, and the management of specific areas, departments, or programs.

The final chapter shows administrators how to go about computerizing their operations. The ideas and methods presented are distilled versions of those used by systems development professionals. Included are discussions of developing a microcomputer implementation plan for a school or district; generating detailed specifications for the system; selecting software, hardware, and a microcomputer network; and implementing the system.

The School Office of the Near Future: A Scenario

Ed Lanning, principal of Jefferson Middle School, arrived for work at 7:45 Monday morning. After logging onto his desk-top microcomputer, he began to read his mail on the screen. His secretary wanted his approval on several letters before having them printed and mailed. Several teachers had sent messages, including a request for a special materials purchase, two notes on disciplinary actions, and a suggestion from the English teacher for a new textbook. Dave Morgan, the assistant superintendent for budgeting in the central office, had left a message requesting the transmission of Jefferson's tentative budget for the coming year. The last two messages were from other principals in the system, both responses to Ed's ideas on food service management, which he had recently posted on the district's electronic bulletin board.

Ed went right to work. He displayed the letters needing his approval one at a time, and, after making small changes in two of them with a screen editor, sent a message to his secretary's mail file indicating his approval of the now corrected letters. Next, he displayed the request for special materials, checked the school's materials budget balance, and then issued a coded approval for the purchase. He reread the notes on disciplinary actions, entered the notes into the students' files, and sent confirmations to the teachers. He entered the suggestion from the English teacher into a curriculum review file, which would be reviewed when the curriculum committee met next month. Next, he sent a response to Dave Morgan, indicating that the final budget request would be transmitted later that day, after a final meeting with the budget advisory committee. Finally, he filed the responses from the two principals in his correspondence file and sent a short message back to one of them.

Ed Lanning leaned back in his chair and reflected on the electronic message system he had just used. All the management microcomputers in the school—his, the assistant principal's, those in the school office, and those on each teacher's desk—were connected to the same "local area network" (LAN) via a common cable. Staff members communicated with each other frequently through the network, sending messages to individuals or broadcasting messages to everyone in the network. Teachers often used the network to retrieve computer-based lessons from either the school's central software library—residing on a "hard disk" drive in the school office—or from other teachers, most of whom maintained small personal libraries of lessons on floppy disks. Teachers used their desk-top micros to keep student records, to communicate with other staff members via the network, and, most importantly, to monitor and manage students' progress on the instructional microcomputers connected to the teachers' desk-top micros.

Jefferson Middle School's local area network was also linked to the district's local area network. This network connected all the district's schools and the central office via the phone lines and automatic dialup and receiving modems. Principals were communicating much more frequently with each other since the districtwide LAN had been implemented. Ideas and data flowed daily between schools via the LAN. Communications between the schools and the central office had been considerably facilitated as well. Even teachers were utilizing the district's LAN to utilize lessons stored in other schools' libraries and to communicate ideas and information with teachers in other schools.

The "integrated management software" that operated on the administrative and office computers allowed Ed and the rest of the administrative staff to transmit information easily between different files and programs. Ed remembered how easy it had been to develop last year's Title I report, which involved analyzing student records and Title I expenditures,

drawing up tables and graphs, and preparing a final report. He had accomplished all this without getting up from his terminal and without handling any paper at all. Thinking back a few short years, Ed wondered how the school ever got along without these machines.

To some, this scenario may sound like an idealized vision of education in the year 2010. But in fact every aspect of the information system described above is in use today in business, government, and academic institutions. As the cost of the hardware drops, as the power and availability of the microcomputer grow, and as the quality and sophistication of software increase, these revolutionary tools for information management percolate down through society.

Inevitably the public school will adopt the new technologies, if for no other reason than to save money. Like the typewriter and telephone before them, the new-fangled microcomputers and networks will become de rigeur in organizations of every type. So for the central office or building-level administrator, the question is not "Will the information revolution affect education?" but "How can I bring my school or district smoothly into the information age, which is already upon us?"

This task is not as difficult as it may sound. Administrators already know most of what they need to know to computerize. They know their schools and districts. They know how and what information flows from point to point, and they know what information people in the district want and need.

Now, a new set of tools—microcomputers—has come along that can make the entire management information system in a district or school more efficient, more economical, and more capable of achieving desired ends. It is up to school and district administrators to incorporate these new information tools into the management mainstream, and it is the purpose of the remaining chapters of this digest to show how this can be done.

Management Uses of Microcomputers

Asking what computers are good for in educational management is akin to asking what administrators do with their time. School administrators, assisted by their support staffs, manage people, programs, money, and physical resources. A large part of these management tasks involves accessing, manipulating, and transforming information; needless to say, managing information is what computers do best.

Many administrators are intimidated to some degree by computers, in large part because of a lack of knowledge about computers and their uses—that is, a lack of "computer literacy." These feelings are exacerbated by the seemingly endless stream of technical facts and specifications that must be known to really "understand" computers.

To counter such feelings from the very start, administrators should think of computers as simply tools—on a par with copiers, typewriters, filing cabinets, and telephones. Computers simply help administrators do what they already do—manage information. Admittedly, computers are much more complex than other office tools, but as a tradeoff they are also much more useful.

To help conceptualize what computers can be used for in educational management, first think of the information system as it currently exists in most schools or districts. Numerous filing cabinets contain records on students, personnel, programs, inventories, budgets, purchases, payrolls, and on and on. Information in these files is regularly "pulled," examined, analyzed, modified, added to, or deleted. It may be compared to or compiled with other information for inclusion in reports, letters, or memos. It may be copied, rewritten, reorganized, or graphed. It may be communicated via letters, reports, telephone calls, or face-to-face meetings.

Now imagine a school or district information system performing all the same functions but utilizing 90 percent less paper. Records are stored, updated, deleted, analyzed, and transformed electronically, without ever going through a "paper stage." Communications of all kinds—reports, memos, messages, and so forth—are more often than not sent electronically from one microcomputer to another. Paper as an information storage and communications medium becomes the exception rather than the rule in school management.

Within a decade this "paperless office," as it is called, will be the norm in all types of organizations, because electronic information systems are, or are rapidly becoming, cheaper, more versatile, and more efficient than their paper-based counterparts.

In the following pages, the major areas for computer use in educational management will be described. Included are discussions of applications in record keeping, data analysis, word processing, graphics production, communications, and the management of specific programs or budgets.

Database Management Systems

A wide variety of school records can be stored and manipulated using microcomputers:

- ☐ Student records, including grades, test scores, attendance and discipline data, class schedules, and family information
- ☐ Personnel records, including information on salaries, evaluations, sick leave, and class schedules
- ☐ Inventories of school equipment and supplies
- ☐ Financial records, including accounts payable and receivable, purchase orders, payroll, and school and district budgets
- ☐ Records on special management areas or programs, such as transportation (bus routing, fleet maintenance, energy

usage), food service management, energy management, custodial service management, sports program management, and special management

As can be seen, computers make ideal filing cabinets. Records of all sorts—student, personnel, inventory, financial—can be stored, recalled, or printed using "file management" programs that have been improving for decades.

Of course, it is often necessary or desirable to compare, compile, or otherwise analyze the information contained in these computerized records. Over the years, numerous sophisticated computer programs—often system or file specific—have been developed for these analysis tasks. Today, record keeping and data analysis are most often performed by single programs called "database management systems" (DBMS). (These programs are part of a larger trend toward "integrated management" systems, which are essentially the most commonly used computer programs—database management programs, word processors, spreadsheets, graphics programs, and communications programs—combined into one versatile and easy-to-use program.)

DBMS allow a district administrator, for example, to compare the achievement of students from a particular area of town (as determined by their zip codes or street addresses) with the cost of educating these students (as determined by, say, the percentage of these students in Title I programs), and then, if desired, to graph the results. All the searching, classifying, compiling, and computation is done by the program. (Of course, both simpler and more complex analyses are possible.)

To give another example, a school administrator may simply want to send a certain letter to the parents of exemplary students. This task could be so simple with a modern integrated management system that the administrator may not even assign it to an office worker. If the desired letter were already written and in the computer, the administrator could

use the database management program and the word processor's "mail merger" (to be discussed below) in concert to perform the task with a few keystrokes.

Presently, the most popular database management program for microcomputers is "dBase II," produced by Ashton-Tate. Many other DBMS programs—some more sophisticated and easier to use than the relatively "old" dBase II—are currently available. New and revised DBMS are constantly appearing on the market, often as central elements of integrated management packages.

David Kruglinski provides an excellent and comprehensive survey of the major available DBMS programs in *Data Base Management Systems: A Guide to Microcomputer Software* (1983). After explaining the different types of DBMS, Kruglinski shows the reader how to evaluate DBMS software and then provides his own comparative analysis of several DBMS programs. Carl Townsend, in *CP/M Database Management Systems* (1983), surveys an even larger range of DBMS, all of which are designed to run under the popular CP/M operating system.

Robert A. Byers provides another good introduction to DBMS in *Everyman's Database Primer, Featuring dBase II* (1983). This primer was prepared by Ashton-Tate, makers of dBase II, but nonetheless provides a good starting point for those interested in DBMS in general. For those already using dBase II, Adam B. Green's *dBase II User's Guide, Revised Edition* (1983) is an essential companion to the standard dBase II documentation.

Electronic Spreadsheets

Another class of useful data analysis programs is the so-called "electronic spreadsheet." These programs are particu-

larly well suited to making budget projections and analyzing the expenditures of departments, programs, and other organizational subunits. They most closely resemble an accountant's worksheet, with each "cell" (an intersection of a row and column) corresponding to a particular element of a classified budget or financial plan. With an electronic spreadsheet, each time the user changes the amount in one cell, the whole spreadsheet can be automatically recomputed—a tremendous advantage over pencil-and-paper worksheets. Moreover, a variety of mathematical and statistical analyses can be performed on the data in the spreadsheet at the press of a button.

Spreadsheets, says Fred Huntington, "allow even the novice to make complicated budget projections based on a number of variables." For example, a school principal studying an instructional aide's costs "could tell in less than a second what all his costs would be if insurance benefits were to increase two percent or if a three percent raise was given instead of a five percent raise."

The first electronic spreadsheet was "Visicalc," which rose to fame with the Apple II microcomputer. Today, over a hundred spreadsheet programs are on the market, and more seem to appear daily. As with DBMS programs, spreadsheets are often sold as parts of integrated management packages, such as "Lotus 1-2-3."

Probably the best source for those contemplating a spreadsheet purchase is *Spreadsheet Software from Visicalc to 1-2-3* (1983) by Thomas B. Henderson, Douglas Cobb, and Gena Cobb. Written by experienced spreadsheet users, this book comparatively reviews most of the major spreadsheet programs and provides tools to help potential purchasers decide which spreadsheets have the features they need.

Most other worthwhile books on spreadsheets are geared to specific spreadsheet programs, such as Visicalc, Supercalc, Multiplan, or 1-2-3. Some of these books, such as Douglas Hergert's *Mastering Visicalc* (1983), are essential supplements to the often less-than-lucid documentation accompanying these programs.

Word Processing

A few years ago, "correcting" electric typewriters replaced most standard electric typewriters in offices everywhere. Before that, "electrics" replaced "manuals," and, long ago, manuals replaced handwriting as the standard means of producing business letters and reports. In each case, the new technology replaced the old because it was more efficient, more cost-effective, produced better results, or some combination of these factors.

Now, of course, word processors are replacing the "inferior" Selectrics and other correctables. Word processors are even replacing electrics, manuals, and handwriting in a large number of homes. A clearly "better" technology has arrived for producing printed material, and it will soon be standard equipment everywhere.

There are two main types of word processors. "Dedicated" word processors are computers dedicated to word processing alone (and perhaps a few other closely associated functions like mail processing). "Nondedicated" word processors are simply programs that run on general purpose computers, such as an Apple or IBM PC. Dedicated word processors are fine if you *just* want word processing capabilities. General purpose computers are best if you're contemplating using the same machine for other purposes, such as database management.

Word processors offer significant advantages over even the best electric typewriter. Once typed in, a letter or report can be stored indefinitely on a minute section of "floppy disk" or magnetic tape. It can be recalled with ease from these data storage media and edited by inserting and deleting text, moving sections of text around, or merging other reports, sections of reports, tables, graphs, or charts from other files into the text.

Corrections, whether involving typos or whole paragraphs, can be performed electronically, without "whiteout" or sci-

ssors and paste. Spelling can be checked and errors flagged by "spelling checker" programs. The margins, tab settings, and so forth can be adjusted easily, and the same report can be printed or viewed at the terminal in a variety of formats. The text can be left and right justified or typed in columns at will. A large variety of typefaces and fonts can be used.

Form letters can be produced, then merged with a mailing list to produce a stack of "individualized" form letters. Or, the letter or report needn't ever be printed; it can instead be transmitted to recipients electronically via a modem and the phone lines or via direct computer-to-computer links. Finally, word processors can be used to print or fill out special forms, such as labels, purchase orders, checks, state and federal forms, and so forth.

With all these advantages combined with plummeting costs and increasing "user friendliness," it is clear that word processors, whether dedicated or not, will soon displace most existing typewriters, including those in school offices.

The rapidly spreading use of word processors in offices everywhere has produced a plethora of books on this new way of writing. For example, Timothy Foster and Alfred Glossbrenner provide an excellent and very readable guide in *Word Processing for Executives and Professionals* (1983). These authors contend, as do many other observers, that word processors will alter the way executives work, even those who now don't type at all.

Mitchell Waite and Julie Arca provide an excellent overview of word processing applications in *Word Processing Primer* (1982). More than enough information is presented to enable an administrator to understand and intelligently evaluate existing word processing programs.

Randy Goldfield provides a detailed introduction to the world of word processing in *Implementing Word Processing* (1983). Included are instructions and forms for conducting word processing needs analyses, a buyer's guide to word pro-

cessing equipment, discussions on training of office workers, and a word processing glossary. Other comprehensive introductions to word processing include Hal Glatzer's *Introduction to Word Processing* (1981) and Ivan Flores' *Word Processing Handbook* (1983). Finally, several periodicals, such as *Office Administration and Automation*, frequently run articles on various aspects of word processing.

For those administrators with severe cases of computer phobia, Peter A. McWilliam's *The Word Processing Book: A Short Course in Computer Literacy* (1982) is highly recommended. McWilliams writes in a humorous, irreverent, and extremely human style that will have even rigid computer phobics laughing at themselves. Best of all, the book is packed with solid introductory material on computers and word processing.

Numerous other books exist on word processing. Many of these are tutorials on a specific word processing program and are meant to supplement or replace the word processing program's reference manual.

Graphics

Graphics programs allow users to generate a variety of visual aids such as charts, graphs, and drawings. Some graphics programs offer a standard set of pie charts, bar graphs, and so forth. More sophisticated programs offer the user complete artistic range, including the ability to make freehand drawings or "paint" with a full range of colors. The images produced can be transferred to "hardcopy" form with a printer, plotter, or other device, or they may be stored or communicated electronically.

Most graphics programs allow the user to create sophisticated graphs and pictures using relatively simple commands or a screen pointing device such as a "mouse." The epitome

of this ease of use is the Apple Macintosh computer (introduced in early 1984), with which a complete novice can create and print sophisticated graphics in literally minutes.

Valuable surveys of computer graphics applications can be found in Joan E. Scott's *Introduction to Interactive Computer Graphics* (1982) and Mitchell Waite's *Computer Graphics Primer* (1979), both of which assume that the reader has no prior experience with computer graphics. Almost all other books on computer graphics are either technical in nature or are geared to specific microcomputers.

Communications and Networking

Another major area for microcomputer use in educational management is communications. Using their desk-top micros, administrators can communicate with other administrators, office staff, individual teachers—even with students and parents at home. In addition, micros can be used to tap the information stored in other computers' memories, whether those computers are five feet or five thousand miles away.

Sending messages from computer to computer is usually called "electronic mail." In a typical system, a user types out a message or letter and then tells the computer to whom it should be sent. The same mail can be sent to any number of individual users or to everyone connected to the system. Messages can also be posted on "electronic bulletin boards" for optional viewing. Recipients are notified they have mail either immediately—if they are connected to the system—or the next time they "log in" to their computer. They can reply to their mail at any time, "file" it in the computer, delete it, or forward it to other users.

Besides electronic mail, computer communication systems can transfer any information held in one computer to another computer. Such information can include manuscripts, data

files, graphics, and other computer programs. Moreover, the information can be transferred across the room or across the country with equal ease. Using these communications capabilities, an administrator can readily "plug into" a computerized database anywhere in the country (or the world for that matter), conduct a search for desired information, and have that information printed on the screen or stored in the computer's memory.

Microcomputers can be connected to other computers in two primary ways. The most common method at present is via the phone lines and devices at each computer called "modems." Modems translate the digitally coded message produced by the sending computer to a series of high and low pitches on the phone line. The modem at the receiving end translates the pitches back into low voltage digital signals that the receiving computer can understand.

Using modems and the phone system, microcomputers thousands of miles apart can transfer short messages or long texts. Moreover, neither microcomputer need be manned at the time of communication; one or both can be on "automatic," much like a telephone answering machine. The communicating microcomputers could also be in the same building, of course.

Computers can also communicate via lines dedicated exclusively to intercomputer connections. Systems of such connections are variously called "local networks," "local area networks" (LANs), or simply "computer networks." This digest will use the term *LAN* to refer to such networks.

LANs based on dedicated lines are ideal for connecting microcomputers in an office, a building, or a complex of buildings. Microcomputers that are a part of a LAN using dedicated lines can communicate freely without having to "dial up" the other computer each time and can communicate at much higher speed than their phone-connected counterparts. LANs also allow all micros on the network to share the use of network-licensed software and expensive peripherals such as letter

quality printers and graphic plotters.

The time is coming but is still several years away when LANs will be widely installed at the school building and district office levels. At the school sites, micros on secretaries', administrators', teachers', counselors', and other staff members' desks will be linked into LANs. At the district office, staff and administrator micros will be similarly linked. Modems and phone lines will likely link the LANs in the central office with those in the district's schools.

LANs, say Frank Derfler Jr. and William Stallings, "are the key factor in bringing the kind of increase in productivity to office work that the introduction of automatic machines brought to manufacturing." According to these authors, the productivity of blue collar workers in the U.S. rose 83 percent between 1968 and 1978 due to the introduction of digitally controlled production machinery. A similarly sharp increase in white collar productivity is beginning to occur due to the plummeting costs and skyrocketing capabilities of computers. But this rise in white collar productivity will be inhibited if micros are not interconnected for efficient information exchange.

Derfler and Stallings illustrate this point by depicting the use of word processors in most offices as "paper-transformation" devices. "Paper is put into the system in the form of drafts and notes, and paper comes out in the form of a more or less finished product." The finished paper is then sent or given to someone else, who may read it, file it, or use parts of it for some other report or letter, perhaps produced on a word processor. The relatively inefficient "paper chain" has not been broken in this case. The word processor has the capability for electronic communication, so the same information need never be typed twice, but it often still is.

The point for school administrators is as follows: Unless microcomputers are interconnected efficiently, they will simply become links in the paper chain, and their full potential

for improving school administration will not be met. So it behooves administrators to pay as much attention to networks as to the microcomputers themselves when designing a school or district's electronic information system.

Unfortunately, the implementation of LAN technology is still often fraught with difficulties. What is, in principle, a simple idea—connecting microcomputers together—in practice often turns out to be a complex technical task of trying to get a variety of machines to "talk" to one another. In short, the implementation of LANs is not yet as simple as installing, say, a new phone system.

In a presentation at a recent computer conference, Philip Piele pointed out several major limitations of current LANs. Two problems stem directly from the complexity of this new technology. First, the user who seeks to implement and operate a LAN will inevitably encounter technical difficulties that require the skills of a trained network manager. Second, computer retail stores and LAN vendors, with few exceptions, lack the expertise and practical experience to support the user.

Another problem is especially troublesome for schools, because of the sensitive nature of school records. Very few database management system programs allow for database security when used on a LAN. Piele asks, "Can LAN vendors guarantee that a student will not have access to his or her grades, but that a teacher, or counselor, or principal will have such access? Regrettably, the answer is no." Programs have yet to be written that permit multi-user access—the essence of a LAN—and at the same time restrict access by some users to certain portions of the database.

The fourth limitation concerns copyright. In theory, one of the advantages of a LAN is that all microcomputers on the network can share the same software. In practice, to do so without a licensing agreement is to violate the copyright law. To legally use popular software such as BankStreet Writer or 1-2-3, the user is compelled to buy one package for each

micro on the network. Piele emphasizes "that until popular applications software is available in network versions, or unless an agreement can be reached with the vendor for use of the software on a network, it is illegal to buy a single copy of a copyrighted software package and to copy it to a hard disk for use by several microcomputers on the network."

Given the present state of LANs development, administrators should proceed with extreme caution in this area, keeping in mind both the potential benefits LANs can bring and the potential headaches in their implementation. In future years, LANs will become much more common and their limitations will be overcome.

Among the better introductory books on microcomputer communications are Alfred Glossbrenner's *The Complete Handbook of Personal Computer Communications* (1983) and Neil L. Shapiro's *The Small Computer Connection: Telecommunications for the Home and Office* (1983). These books explain the hardware and software needed for microcomputer communications. The focus of these books is on the equipment and protocols needed to connect to information utilities such as "The Source" and "CompuServe" and to information databases such as the ERIC system. Derfler and Stalling's book on LANs, *A Manager's Guide to Local Networks*, is an excellent, though brief, introduction to networks.

Other Applications

Microcomputers can also be used for a variety of administrative chores that don't fit easily into the above categories. For instance, consider one of the biggest headaches building administrators must endure each academic period—the registration of students and the scheduling of classes. Special programs have been developed for microcomputers that can ease this task considerably. David Mosow and his colleagues report

on one such system, which runs on an Apple II microcomputer.

As mentioned earlier, microcomputers can be used with database management systems and other programs to help manage specific programs or areas, such as food service (see Panna Hazarika and Stephen Galligan's "Automated Information System for School Food Services"), custodial service (see Jerry Kantlehner's "Computerizing Custodial Services"), special education (see James R. McNamara's "Considerations Used in Selecting an Administrative Microcomputer System for Special Education Management"), and sports programs. The routing and scheduling of buses, fleet maintenance records, and fuel usage management also lend themselves to computerization (see articles by C. R. Ebert, Thomas W. Solarek and David Freeman, Barbara Lewis, and James C. Edwards).

Some schools and districts already use small computers connected to thermostats and other electromechanical switches and devices for managing energy usage, often with significant savings (see articles by Edward Kazanjian and Jay Conner). Similarly, microcomputers are used as integral parts of "smart" security systems in some schools and districts.

Finally, there are a variety of applications for microcomputers in schools that are not strictly administrative but that are likely to be interfaced with the micros used for administration.

These applications include the following (as enumerated by Norman Watts):

- ☐ Curriculum planning applications, including the management of resource files for teachers and the production of instructional material
- ☐ Professional development applications such as computer-based courses
- ☐ Library applications such as indexing and searching
- ☐ Research applications utilizing a school's or district's student information files
- ☐ Guidance and special services applications such as standar-

dized testing, vocational counseling, and diagnosis and remediation of learning problems

- ☐ Testing applications, such as test construction, scoring, and evaluation
- ☐ Instructional applications, such as computer-aided instruction, computer-managed instruction, computer literacy training, and teaching computer science

How to Implement the Electronic Office

Within the next several years, nearly all school offices will be computerized to some extent. Typewriters will become passe. Filing cabinets will diminish in number. And microcomputers will appear on the desks of administrators and secretaries alike, performing an ever-widening variety of administrative and clerical tasks.

Like it or not, all school offices are inextricably headed toward a computerized future. But how will the transformation take place in individual offices? Administrators will, of course, handle the transformation quite differently from one another. Some will rush forward to greet the new technology, perhaps stumbling briefly in the new terrain. Others will resist the inevitable until economic pressures force their hands. And still others will usher in the new way of doing things with well-thought-out implementation strategies.

Microcomputer technology is getting so inexpensive, and the economies to be realized are so great, that even many haphazard implementation efforts will produce more efficient school offices. Consider then what can be achieved with a well-conceived plan for implementing the electronic office.

The first section below illustrates the considerable benefits that can accrue to a school from a principal's tinkerings with a microcomputer. Even with no computer experience and a modicum of money, a careful administrator can start his or her school office down the road to more efficient operation.

The next sections describe a more formal process for implementing microcomputer technology modeled after the practices of professional "systems developers." Systems development is a structured process for analyzing, designing, and implementing a computer system. The larger and more complex a computer system, the greater the need for a formal

systems development process. Such an approach is essential for, say, a district adding a network of micros in the central office that will be interfaced with an existing mainframe computer, or with networks in individual schools. But even a small implementation effort can benefit from an application of the principles of systems development. Distilled and dejargonized, systems development is really nothing more than the intelligent planning and implementation of a computer system.

Taking Initiative at the School Site

Most public school systems are what organizational scientists call "loosely linked" hierarchies. This means that, though a hierarchical power structure exists, the lower levels are not necessarily responsive to the dictates from "above," as they would be in, say, a military organization. Lower level members—teachers under principals, and principals under district administrators—often "do their own thing" when guidance from above is either lacking or weak.

This loosely linked nature of school systems, combined with the fact that individuals are often more responsive to environmental changes than to the creeping bureaucracies to which they belong, has led to the phenomenon of the "principal as hacker." *Hackers*, in computer parlance, are individuals who spend a great deal of time playing with computers and exploring their applications. Principal hackers, whether they realize it or not, are at the forefront of the coming wave of school-site computerization.

Consider the case of Fred Huntington, principal of Mark Twain School in Corcoran, California. In a recent article, Huntington offers prospective principal hackers a wealth of advice on how to get started. He describes the main administrative programs that will run on micros and outlines a sequence of implementation for beginners.

To begin with, Huntington recommends that principals become computer literate. To do this, they should read everything they can get their hands on that deals with the management uses of microcomputers and talk to everyone they can find who shares similar interests. "Go through the computer magazines and call the tollfree numbers and pick vendors' brains." "Find out when the local computer/users' groups meet" and attend some meetings. "Buy and read as many computer magazines as possible and talk to friends who have systems."

When implementing your first microcomputer system, Huntington has this advice: "Start slowly and add gradually. Learn each component of the present system before going on to something else. One should not expect to walk in on Monday morning with a new computer and have everything computerized by Friday afternoon."

A good program to start with is a word processor, because it is easy to understand and use and leads to an almost immediate increase in productivity. Obvious first uses include correspondence (with parents, staff, and others), staff bulletins, and various reports. "Most people find that with a word processor, a final, professional-looking copy can be obtained in less time than it used to take to scribble down notes to one's self," Huntington claims. "In many cases, the secretary is no longer needed to type letters and reports."

After getting comfortable with the word processor, Huntington suggests adding a few word processor "peripherals" such as a spelling checker, a thesaurus program, and a mailing list generator for creating "personalized" form letters. At this initial stage, the computer novitiate may also benefit from playing games (after hours, of course), which will build keyboard dexterity and reveal some of the idiosyncracies of the computer.

After word-processing applications, principals should start exploring electronic spreadsheets and other financial pro-

grams. Electronic spreadsheets are excellent for making budget projections; the effects of small or large changes in any row or column of a tentative budget can be seen on the "bottom line" in only seconds. Other financial applications appropriate at this point include programs to calculate payroll, manage school purchasing, and monitor funds generated by extracurricular activities.

The next step is gaining experience with a database management system (DBMS). As explained in an earlier chapter, a DBMS can be used to keep track of and analyze a variety of records, including those for inventory, students, and personnel.

After putting the above programs to work, and perhaps implementing other programs for such specialized tasks as attendance accounting, the principal may find that there are still some repetitive "paper-shuffling" tasks to be done that are peculiar to the school or district. At this point, adventuresome principals may wish to write their own custom programs for certain tasks. For example, a principal in California needs to do about a half-hour of paperwork whenever a student is suspended. Huntington wrote a program to do the same task, reducing his time commitment to about thirty seconds.

Huntington's approach to microcomputer implementation, as outlined above, may be a viable first method for some school-site administrators. The steps are small, and the first application—word processing—can easily justify the several thousand dollar outlay needed for a decent system.

Consider, though, what may happen in a year or two: the system works so well that the school wants to upgrade to a network of micros. Better hardware and software have come out, but the "old" programs won't work on the new hardware being considered. Even if they could, the programs on floppy disks now being used can't be transferred to the new system's hard disk because of "protections" on the copyrighted floppies. In short, the "upgrade" to a new system looks like it could be

a frustrating operation, involving the retraining of clerical staff and leaving familiar programs collecting dust. Many of these upgrade problems can be averted, though, by systematically planning a school's future information system from the very start, as explained in the following pages.

The Systems Development Process

Computers have been around now for close to forty years and have been in widespread use for the last twenty. During this period, a very large number of computer systems have been installed. Many of these systems were, or still are, well suited to their tasks. But many other systems—some would even say most—have had serious design flaws that prevented them from fully meeting their users' needs. Most of these problems have been traced to poor or short-sighted planning on the part of the systems' designers.

Perhaps in response to their embarrassing percentage of failures, computer systems designers over the years developed a set of guidelines for "systems development" that, when adhered to, tended to prevent a large number of these failures. The remaining sections of this chapter explain, in simplified terms, the three phases of structured systems development—analysis, design, and implementation. But first, a word about consultants.

Using a Consultant

Microcomputer systems are getting easier both to use and to implement. Their declining costs make the size of the mistakes that can be made in the systems development process by inexperienced administrators smaller and smaller. But the costs of mistakes can still add up.

Some schools and districts may be able to implement microcomputer-based information systems quite readily utilizing inhouse talent. Others may feel more comfortable working with a consultant, especially when implementing a network to link several micros.

"Consultants sell expertise," says Lynn Weis. "That means they already know how to sift claims of various vendors and review the needs and preferences of school district personnel." On the other hand, consultants cost money. So first review available inhouse talent, consider the size and complexity of the implementation effort, and then decide where a consultant might fit into the systems development process.

Working with a consultant or vendor is highly recommended when planning and installing a local area network (LAN) to link a group of microcomputers. An excellent guide to working with a consultant during network development is *A Manager's Guide to Local Networks* by Frank Derfler Jr. and William Stallings. This book also contains excellent discussions of the systems development process in general.

Systems Analysis

Systems analysis is the process of developing a formal microcomputer implementation plan. The purpose of such a plan, as Gerald Ward and Mark Lutchen explain, "is to provide an overview of the key microcomputer activities that are to be implemented over a specified time period." Because of the rapid rate of change in the microcomputer field at present, these authors recommend selecting a relatively short period for the plan, which will foster the development of more realistic objectives.

The plan should include the following information:

- ☐ a list of the tasks to be computerized
- ☐ a set of priorities for computerizing these tasks

- ☐ a timeline for implementation, based on the priorities
- ☐ a discussion of critical implementation issues and considerations, such as the effect of microcomputer applications on existing data processing facilities
- ☐ a list of specific assignments of responsibilities for the implementation effort

Many potential uses for microcomputers in school administration were outlined in a previous chapter. Other potential uses can be identified by formally or informally studying a school's or district's present information system. Possible applications exist wherever information is now stored, generated, processed, or communicated.

But just because something *can* be computerized doesn't mean it should be. Computerization can often lead to economies, efficiencies, and enhanced capabilities. *But not always.*

Computers are not panaceas. They are information tools that may or may not be beneficial in particular situations. Whether they are or not depends on the nature of the situation and the currently available information tools.

Consider an example from the home computer market, where microcomputers are often advertised for such purposes as storing recipes. This might be appropriate for writing a cookbook, but for the average household cook, the "manual" recipe box does just fine. Equally inappropriate uses for microcomputers can be found in every school. So before deciding to computerize any task, first clearly determine that a computer-based solution is the best available solution.

The development of the microcomputer plan should be a group effort, with input from all potential users of the system. Experience has shown that the systems development process produces much better results when the analysis and design stages are conducted with substantial end-user input, particularly if an external consultant is utilized. An all-too-common result of traditional systems development is a system that

works impeccably, but does not do what the users want it to do. Input in the early stages from all individuals who will eventually use the system—office workers, administrators, and teachers—not only can prevent this unhappy result but also gives the users a sense of "ownership" of the system and reduces their alienation from it. Inexperienced users—especially those cynics who doubt the usefulness of microcomputers—are also especially good at pointing out inappropriate uses for microcomputers.

Systems Design

Systems analysis yields a rough sketch of the information system to be. Systems design fills in the details. This process includes "determining the exact requirements, specifying the tasks to be performed, determining the best way to perform the tasks, and establishing required performance levels," says Jerry Atwood. Systems design, then, starts with the microcomputer implementation plan and ends with detailed design specifications for the software, hardware, and network system to be used.

During the design phase, it is entirely possible that new potential uses may be identified, or that previously identified uses may now appear to be inappropriate. At these points, the microcomputer plan should be revised and the design phase continued.

The written design specifications should include the following:

- ☐ The objectives of each application. "Highlight the major reasons, including key benefits and uses, for the application being implemented," Ward and Lutchen advise.
- ☐ The number of transactions for each application and the frequency of performing each application. This would include, for example, the number of student records and the

time schedules for their processing and reporting.

- ☐ All the "inputs" required for each application, where each input is to be obtained, and the frequency of the input.
- ☐ The specific processing requirements for each application, for example, the methods for computing equipment depreciation or grade point averages. These specifications are especially useful for determining if available programs are suitable for the task under consideration.
- ☐ All the "outputs" to be generated by each application. The formats, frequencies of production, and distribution patterns should all be specified.

The design document, Ward and Lutchen explain, "will serve as the blueprint for the application being implemented; it should be updated and annotated to show modifications made as implementation progresses."

The next three sections discuss three subtasks of the systems design process—selecting software, microcomputer hardware and peripherals, and a network architecture.

Selecting Software

Once the detailed specifications of the system have been outlined, the software to perform the application should be found. Administrative software can be obtained from three primary sources: (1) commercial vendors; (2) other schools, districts, or organizations; and (3) local development.

General purpose programs such as word processing, database management systems, and spreadsheets are widely advertised and are frequently compared and evaluated in publications serving the microcomputer using population *(Personal Computing, InfoWorld, ComputerWorld, Byte)*. More specialized software for educational administration applications, such as student scheduling, energy management, and so forth, is advertised in such publications as *School Business*

Affairs, *American School and University*, and *Technological Horizons in Education (T.H.E. Journal)*.

Many districts and schools have been computerized for years. By one means or another, they have developed or obtained good administrative software, and many are quite willing to share the noncopyrighted software they have acquired.

The Educational Research Service (ERS) has established a "Computer Software Exchange" to facilitate this dissemination process. Contributing school districts complete data sheets for each program they have available, including information on purpose and features of the program, hardware requirements, cost of making copies, and phone numbers of contact people in the district. Requesting school districts—who must be ERS subscribers—request information from the exchange for specific instructional or administrative purposes. The ERS performs a search and forwards copies of the relevant data sheets to the requestor. Current administrative offerings include programs for attendance accounting, energy management, finance, inventory, student and personnel records, testing, transportation, and word processing. For further information contact ERS, 1800 North Kent Street, Arlington, Virginia 22209. Telephone: (703) 243-2100.

Finally, if a desired program cannot be found from any of the above sources, administrators can develop the programs themselves. Who will do the programming? Many options exist:

- ☐ district data processing personnel
- ☐ teachers or administrators with programming skills
- ☐ local college students in computer science
- ☐ outside consultants

Some schools have even used students in advanced high school computer classes to develop useful programs!

Many future headaches can be avoided if the "right" software can be obtained early in the school computerization

process. Ward and Lutchen offer the following checklist for software selection:

- ☐ Does the software package have the capabilities you need? Ask for a demonstration—"seeing is believing."
- ☐ Has the software been widely sold? Does your retail dealer understand the software? Do not help the developer "debug" the software unless you are truly prepared for that approach. Being the "first kid on the block" with microcomputer software packages can bring its share of headaches.
- ☐ Is the operating system software an established system? Again, being unique and outfront has some real risks.
- ☐ Does the software provide facilities for an adequate audit trail? Having the ability to know what transactions were processed is important to most users.
- ☐ Is the software "user friendly"? If you can't learn to use the software in a matter of hours, chances are a better package can be found.
- ☐ Do controls exist to prevent programs from being run in the wrong order?
- ☐ Can authorized changes to the program be made by your own personnel? A program written in some program language may be difficult for you to modify down the road.
- ☐ Is the documentation adequate? Don't be impressed by a fancy binder or a slick brochure. Read the documentation. Can you understand it?

Selecting Hardware

Selecting hardware is relatively easy once good software has been found, because particular software packages usually only run on a handful of machines. Having narrowed the field in this way, the administrator should evaluate computer hardware much as he or she would evaluate other school equip-

ment. Microcomputers and their peripherals are, of course, more complex than other pieces of equipment, and the microcomputer field is changing rapidly. So a guidebook devoted to hardware selection may be appropriate at this point.

One such guidebook is *Microcomputer Reference: A Guide to Microcomputers* by Shirley Douglas and Gary Neights. "Tally" and "comment" forms are included for the evaluation of individual computers. Seventeen criteria, including costs, flexibiiity, keyboard layout, servicing, and user training, are explained and listed with spaces for comments, "importance factors," and "criteria rankings." Importance factors are determined using information on the projected uses for the micros. Criteria rankings indicate how a particular computer rates on the criterion in question. A total score for each computer is calculated by multiplying each criterion's importance factor and rank and then adding.

Douglas and Neights also provide other helpful information for making a hardware purchase, including a nine-page glossary of computer terms, an elemental discussion of how computers work, and a list of organizations and consortia involved in educational computing.

The Northwest Regional Educational Laboratory, in *Microcomputers in Today's Schools: An Administrators' Handbook*, also discusses the process of acquiring computer facilities, including the all-important steps of justifying the procurement of computers and conducting a needs assessment. Advice on acquisition is proffered according to the experience and knowledge levels of the responsible administrator, whether low, medium, or high.

Selecting a Network

As mentioned earlier, efficient communications links between an organization's various microcomputers will be the

key to building a streamlined electronic school information system. Designing and installing a network are complex tasks, and most schools and districts will probably need to a hire a consultant or vendor to assist in this process.

This does not imply, however, that administrators should be detached from the network's design and implementation. As Derfler and Stallings point out in their excellent book, *A Manager's Guide to Local Networks*, managers should have enough knowledge to hold their own when dealing with "the experts and would-be experts," but they needn't master the technical details. Administrators should be concerned with "*what* the network will do, not *how* the network will do it. The *what* is the customer's responsibility; the *how* is the vendor's responsibility."

Derfler and Stallings outline the following criteria for selecting a network:

- ☐ Cost. "If the cost exceeds what you perceive as the expected savings in increased productivity, then the system isn't worth the price."
- ☐ Meets requirements. The network must meet the requirements of your microcomputer implementation plan.
- ☐ Readily expandable. The network should be "expandable with only incremental cost." This means that if you put in now what you can afford, "there should not be a big retrofit job later to expand the system." This allows schools and districts to "start small, at low risk, and gradually expand the network" to meet more and more needs, such as, for example, interfacing eventually with teachers' microcomputers.
- ☐ Interfaces easily. The network should be capable of interfacing with a large variety of equipment supplied by multiple vendors.
- ☐ Ease of installation, maintenance, reconfiguration, and interconnection.

Derfler and Stallings go on to show how to identify specific network requirements, choose a network configuration, and choose a vendor. Many of their suggestions are based on an excellent publication put out by the National Bureau of Standards, *The Selection of Local Area Computer Networks* (See Rosenthal).

Keep in mind that selection of a network also requires selection of someone to manage it. In a recent article, Piele points out that

> one cannot just buy a LAN at the local computer store, take it to one's workplace, plug it in to two or more microcomputers, turn it on, and start transferring files, sharing printers, and accessing databases. Someone has to take responsibility for such things as installing and debugging the network, writing special programs so single-user applications software will operate efficiently on the network, writing a network users' guide, and managing printer access and output. In short, every local area network needs a manager. Such a person must have a combination of problem solving skills, systems-programming expertise, and management training or experience.

The decision to purchase a LAN requires, therefore, a commitment to recruit someone with the talent and interest to manage it and to train that person in the technical aspects of the network's operation.

Systems Implementation

Systems implementation, the third major phase in the systems development process, includes hardware and software purchase, installation, changing over from the old information system to the new, and the training of personnel. When systems implementation is complete, the new computer system will be completely integrated into the school or district's information system.

During the implementation phase, the new and old information systems may be operating side by side at times. In addition, unfamiliarity with the new tools and methods, resistance or "computerphobia" on the part of some staff members, and the extra work involved in entering old data into the new system may lead to a temporary *decrease* in office productivity. As the new system begins working, though, office productivity will grow rapidly.

For Further Reference

In the past five years, over 125 new periodicals dealing with personal computing have started publication. Paralleling this boom in periodicals is a boom in microcomputer-related books. Literally thousands of different titles are currently available, a large proportion of which were published since 1981.

Unfortunately, very few of these new books are geared to the specific needs of school administrators. On the other hand, much of the information in these books is common to all users or is readily adaptable to the needs of school managers.

Probably the very first book computer novices should acquire is Cris Popenoe's *Book Bytes: The User's Guide to 1200 Microcomputer Books* (1984). This book—a knowledgeable, intelligent, and easy-to-read annotated bibliography—describes the best of the available microcomputer books. The books are divided into five major categories—introductory, machine-specific, business applications, programming, and artificial intelligence—and a host of subcategories. Author and title indexes are included, along with complete publication and ordering information. Popenoe plans yearly updates of this valuable reference.

The previous chapter included references to noteworthy books and articles on school management applications of microcomputers—database management, electronic spreadsheets,

word processing, graphics, communications, and other applications. Here attention is given to books giving guidance for selecting and implementing a microcomputer system. All these books are primarily geared to either business people or individuals with micros. Their content, however, is readily transferable to school administration.

According to Popenoe, three guidebooks to microcomputer systems development stand above the rest: *The Business Guide to Small Computers: How to Determine Your Needs, Choose Equipment, and Implement the System* (1983, by Lawrence Calmus; *How to Select a Business Computer* (1982) by Billie Cayot and others; and William E. Perry's *So You Think You Need Your Own Business Computer: The Manager's Guide to Selecting, Installing, and Using the Right Small Computer System* (1982). Each of these books takes a different approach, but all three share traits of readability, thoroughness, practicality, and usefulness (as reflected in the numerous checklists, worksheets, and detailed instructions they contain).

Many other excellent books—some with titles very similar to those noted above—are available, among them Mark Birnbaum and John Sickman's *How to Choose Your Small Business Computer* (1983), Hillel Segal and Jesse Berst's *How to Select Your Small Computer ... Without Frustration* (1983), and Edward M. Cross's *How to Buy a Business Computer and Get It Right the First Time* (1983). Segal and Berst's book is the most "user friendly" of this group, while Cross's book is especially attentive to the legal intricacies of contracting with vendors.

Conclusion

Microcomputers have a variety of uses in the school office. They and their associated networks and peripherals will soon displace large portions of the paper-based information system now in use in every school organization.

Even without an organized development effort, many schools and districts can benefit from these new information tools, at least at first. But with a well-conceived and organized systems development effort, school organizations of all types and sizes can reap the maximum benefits from the microcomputer revolution and stride confidently into the information age.

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